Quantum Optics P572 Teaser Question Feb. 5, 2015

Question: *Continuous quantum Zeno effect.*

Consider a two-level system $|1\rangle$, $|2\rangle$ with Hamiltonian $H = \Omega\,|2\rangle\langle 1| + \text{H.c.} - i\gamma\,|2\rangle\langle 2|$. The second term arises – as we saw in class – because $|2\rangle$ emits photons to the electromagnetic field, and wherever the atom decays to when it emits a photon, it doesn't end up in state $|1\rangle$.

For an atom that starts in state $|1\rangle$, consider the probability that the atom is in state either $|1\rangle$ or $|2\rangle$ (i.e. it hasn't emitted a photon) after a short time t, $|c_1|^2 + |c_2|^2$. What does this look like, for a fixed t and Ω, as a function of γ? Do the calculation if you can. *Hint: it is formally identical to how you we do adiabatic elimination in class, with γ rather than the detuning the fast variable.*

Previously in your physics career, you have likely encountered the quantum Zeno effect, where repeatedly, rapidly, and projectively measuring a system halts its time-evolution. How is the present situation related?